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Proceedings Series 2011/021 | **Compte rendu 2011/021**

Maritimes Region | **Région des Maritimes**

Proceedings of the Maritimes Region Science Advisory Process to Review the Assessment Framework for Lobster Fishing Areas (LFA) 27-33 Lobster

February 1-3, 2011
Dartmouth, Nova Scotia

Ross Claytor
Meeting Chair

Compte rendu de la réunion tenue dans le cadre du Processus consultatif scientifique de la Région des Maritimes pour examiner le cadre d'évaluation du homard des zones de pêche du homard (ZPH) 27 à 33

1-3 fevrier 2011
Dartmouth (Nouvelle-Écosse)

Ross Claytor
président de la réunion

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September 2011 | **Septembre 2011**

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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Septembre 2011

ISSN 1701-1272 (Printed / Imprimé)
ISSN 1701-1280 (Online / En ligne)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/

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Correct citation for this publication:
On doit citer cette publication comme suit :

DFO. 2011. Proceedings of the Maritimes Region Science Advisory Process to Review the Assessment Framework for Lobster Fishing Areas (LFA) 27-33 Lobster; February 1-3, 2011. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/021: iv + 28p.

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SUMMARY

A Maritimes Region Science Regional Advisory Process (RAP) was conducted on February 1-3, 2011 at Northwest Atlantic Fisheries Organization (NAFO) Headquarters in Nova Scotia to conduct a framework assessment for Lobster Fishing Areas (LFA) 27-33 Lobster. Participation in this meeting included Fisheries and Oceans Canada (DFO), Province of Nova Scotia, the fishing industry, and aboriginal communities. The results of this meeting will form the basis for the subsequent assessments of LFA 27-33 lobster.

SOMMAIRE

Une réunion s'est tenue dans le cadre du Processus consultatif scientifique de la Région des Maritimes les 1 au 3 février 2011, au siège de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO) en Nouvelle-Écosse. Elle avait pour but d'examiner le cadre d'évaluation concernant le homard des zones de pêche du homard (ZPH) 27 à 33. Y participaient des représentants de Pêches et Océans Canada (le MPO), de la province de la Nouvelle-Écosse, de l'industrie de la pêche et des communautés autochtones. Les résultats de cette réunion constitueront les éléments de base des évaluations subséquentes du homard des ZPH 27 à 33.

BACKGROUND

The status of the lobster resources in Lobster Fishing Areas (LFAs) 27-33 was last assessed in 2004. Fisheries and Aquaculture management has requested updated information on the status of the LFA 27-33 lobster stocks, and a new assessment framework is required to establish the scientific basis for the provision of management advice in 2011. These proceedings describe the conclusions of a meeting held from Feb.1-3, 2011 to develop this new assessment framework.

Currently there are no fishery independent abundance indicators for the lobster fishery. As a result, it is important to understand how environmental, management, and fishery changes (e.g. changes in effective effort) influence the interpretation of fishery-dependent indicators with respect to stock status and changes in abundance. This interpretation will be important in deriving reference points for lobster stocks, as landings are currently identified in the Integrated Fisheries Management Plan as the primary source for reference points. Recognizing that landings are an insensitive indicator of changes in abundance, there is a need to develop reference point indicators that are more sensitive to changes in abundance. An important objective of the framework was to identify those data collected in association with the fishery that would be more sensitive to changes in stock status than landings and to begin initial discussion on improved candidate reference points.

The Terms of reference (Appendix 1), Draft Agenda (Appendix 2), and Invitation list (Appendix 3) defined the objectives and participants for the meeting.

Framework Objectives

The framework addressed the following objectives:

1. Identify groups of LFAs for stock assessment
2. Identify links between life-history (size-at-maturity, recruitment) and lobster management (update and reporting on information and assumptions used).
3. Identify strengths and weaknesses of fishery data inputs for providing indicators of abundance, size structure, recruitment, effort, spatial distribution of catch.
    a. Port and at sea sampling protocols
    b. Observer sampling (including bycatch sampling associated with SARA)
    c. Logbooks
    d. Fishermen and Scientists Research Society (FSRS) information
4. Select indicators of abundance, with a focus on a proposed catch rate model.
5. Select indicators of recruitment and reproduction (spawners)
6. Select indicators of fishing pressure.
7. For the selected indicators develop candidate reference points that would form the bases for decisions by Fisheries Management.
8. Development of an assessment schedule, including guidelines for the monitoring of the indicators and other events that would trigger an earlier than scheduled assessment.

Introductory information was provided on the lobster biology most relevant to lobster fishery management and assessment. The main conclusions were:

1. Natural mortality (M) on pre-settlement lobster is thought to be very high, greater than 95%.
2. M on adults – legal size animals is assumed to be 10-15% across all sizes.
3. In spite of high mortality at the pre-settlement phase, work in Maine indicates there is a weak stock recruitment relationship overall but at a scale of 36 km in west Gulf of Maine

72 km in east Gulf of Maine a strong relationship exists. Thus, at appropriate scales stock biomass is an important controller of future stock size.
4. The body of evidence indicates that larger lobsters are multiple breeders resulting in increased egg production and a greater diversity of breeders that should lead to more successful egg production.
5. The group did not review the work that supports the conclusions from items 1 - 4.
6. As indicators are considered, the biological effects that are important will be explicitly identified and methods for investigating any uncertainties on utility of the indicators for identifying stock status will be identified.

Conclusions Objective #1: Identify Groups of LFAs for Stock Assessment

Cluster analysis on landing trends from 1947 to 2009 identified groups of Lobster Fishing Areas (LFA) for stock assessment. This analysis indicated three LFA groupings were appropriate: LFA 27, LFA 29-32, and LFA 33. Size at maturity, genetics, environmental differences and differences in fishing season supported these groupings. There were insufficient landings data to include LFA 28 in the analysis and this small LFA (Bras d'Or Lake) could be grouped with either LFA 29-32 or LFA 27.

The meeting **concluded** that these groupings would be used to provide advice on status of lobster. These groupings would allow increased data to address population and biological questions. However, if fisheries management advice were required for a particular LFA, these questions would still be addressed at the LFA level if appropriate data exists. For example, a finer scale may important for answering advice requests that depend on stock recruitment relationships. We also concluded that LFA 28 would be included in the LFA 29-32 group and this relationship is identified in the proceedings framework (Appendix 5).

The relationship of LFA 33 west to LFA 34 and LFA 33 east to LFA 32 was discussed but was outside the Terms of reference of this meeting.

Research Recommendations Include:

1. Investigating robustness of the grouping conclusions could be done by:
   a. Splitting the time-series
   b. Using resampling methods such as randomization and bootstrapping to assess the robustness of the classification.
   c. In the longer term, exploring the application of more recently developed functional data analysis clustering to the time series, to assess whether there is added value in using the order of the fishing seasons
2. When the groupings are revisited (i.e. at the next framework), new data on larval dispersal, genetics, size of maturity, and catch rates (a longer time series of catch per unit effort, CPUE) should be included in this analysis.
3. If landings are to be used as indicators of changes in abundance there should be consideration for changes in effort resulting from major changes in the fishery. For example, a switch from groundfish effort to lobster effort occurred after the groundfish moratorium in 1992.

Conclusions Objective #2: Identify Links Between Life History (Size of Maturity, Recruitment) and Lobster Management (Update and Reporting on Information and Assumptions Used)

Recent analysis on size of maturity, as determined using cement gland stages, was presented for Dingwall (northern) and False Bay (central) in LFA 27. In addition, the analysis examined a southern site, Petit de in Grat, located on Isle Madame in LFA 29. Preliminary data summaries presented for Canso, Tangier (LFA 32), Port Mouton (LFA 33), and Lobster Bay (LFA 34) described recently completed field samples.

It was concluded:

1. Estimates of size of maturity varied by week within a season, spatially within an LFA, and annually. This variability should be considered in reporting and interpreting long-term changes in size of maturity.
2. The logistic analysis as demonstrated for LFA 27 and 29 is suitable to indicate if the minimum legal size was above the current size of maturity and to provide a range of the percentage of lobster in the trap catch that can spawn before harvesting in each LFA.
3. The logistic model using cement glands only as an indicator of size at maturity should be applied to the recent data. This should be compared with using cement glands and external eggs as indicators of size at maturity.
4. That this analysis was not suitable for commenting on the reasons for any changes in size of maturity, (if additional environmental or fishery data were available these could be incorporated with the type of analysis used);
5. The size of maturity or percentage mature at current MLS may provide indications of stock health, but interpretation of increases or decreases in these measures as positive or negative require further consideration.

Research Recommendations:

1. Subsequent sampling should focus on documenting the identified weekly, spatial, and annual effects and collecting data to interpret the changes observed with respect to current stock status and any effects resulting from increased or reduced fishing pressure.
2. Standardizing size of maturity estimates by removing spatial and temporal effects.
3. Given that egg-bearing females are protected, male size at maturity is expected to be more sensitive to exploitation. In the future, male size at maturity and changes in sex ratio should be evaluated to determine their use as indicators of exploitation.

Suggestions to Clarify the Robustness of the Analysis:

1. Plot observed data simultaneously with fitted lines
2. Where possible, present SOM analysis of both cements gland staging and berried females.
3. Present diagnostics including AIC values and residuals.
4. Present data to demonstrate that entire temporal and spatial extent of the stock was covered (there were questions on whether or not important depths or migration timings were covered).

Conclusions Objective #3: Identify Strengths and Weaknesses of Fishery Data Inputs for Providing Indicators of Abundance, Size Structure, Recruitment, Effort, Spatial Distribution of Catch

Strengths and weaknesses of the data sources are summarized in Appendix 4. The discussion on these strengths and weaknesses is provided below.

Compulsory Logs:

Weakness:

Influenced by potential management implications – weakness of compulsory logs
No place for berried lobsters
Only marketable portion of the catch is available, excludes egg carrying females and under size

Strength:

Digital entry of compulsory log makes reporting faster
Soak days can be calculated with some comment on uncertainty
In spite of some quality control issues, 90% of data is useable
Most complete data set about composition of catch during fishing season and geographically referenced (latitude and longitude).
Includes egg carrying females

Voluntary Logs:

Weakness
Depends on personal contact – weakness

Sea Samples:

Strengths
Add soft shell to data collected

FSRS Recruitment Traps:

Weakness
Continued collection depends on governmental funding

FSRS Commercial Traps:

Weakness
Continued collection depends on governmental funding

Conclusions on the use of these data are included in the specific applications in the conclusions below.

In assessing the strengths and weaknesses of the FSRS recruitment traps it is important to keep in mind the original objectives of the project as given below:

The project was designed to study changes in abundance of juvenile lobsters that will be recruited into the lobster fishery in the upcoming seasons and, as the project continues, allow an index of recruitment to be developed. The project collects information from standardized project traps on number of males and females, number of juvenile lobsters and length of juvenile lobsters, required to develop a recruitment index.

Research Recommendations:

1. Conduct quantitative comparative studies by examining the spatial and temporal overlap in various sampling regimes and respective conclusions to optimize the program and ensure best use of resources.
2. LFA 33 commercial trap project has 44 participants and the data provided should be examined to determine its use as information characterizing the commercial fishery and putting the recruitment trap data into a fishery context.
3. Checks could be added to data entry screens.

Suggestions that Would Help Clarify the Robustness of the Analysis:

1. Provide information on whether traps are clustered or alone to provide insight on the potential for trap interference.
2. Strengths and weaknesses are related to the goals of any particular study; include a statement on goals in the strength and weakness tables.

Conclusions Objective #4: Select Indicators of Abundance, with a Focus on a Proposed Catch Rate Model

Temperature Corrected Abundance Index (TCAI) for LFA 33 Pre-recruits:

Model based estimates of a temperature-catchability relationship for lobsters just below the legal size limit (pre-recruits), a temperature-corrected catch-per-unit-effort (CPUE) based abundance index (TCAI) and a spatial abundance index for a non-exploited class of a population of lobsters were presented. The samples were based on standardised traps (FSRS recruitment traps) monitored continuously throughout the lobster fishery by the Fishermen and Scientists Research Society (FSRS) and water temperature recorders retrieved at the end of each season. The TCAI was obtained from a probabilistic model of the catch from a single sampling event as a function of the number of lobsters available at the sampling location, the current temperature, and the catchability-temperature relationship. The model was applied to data from three Nova Scotia (Canada) lobster fishing area (LFA) management zones, LFA 34, LFA 33 and LFA 27. In LFA 34 and 33, there was a strong association between catchability and water temperature, suggesting that the TCAI is more suitable than the CPUE for these LFAs. The model was supported by diagnostics. In LFA 27, diagnostics showed a weak relationship between catchability and temperature, suggesting that the TCAI is not better than the CPUE for this LFA. Additional analysis of the model residuals suggests that agonistic behaviour does not affect catchability from these traps.

Research Recommendations:

Temperature is related to other variables, depth and distance from shore. As a result, a multivariable approach using GLM and GAM may improve fits and explanatory power.

Suggestions to Clarify Presentation Included:

1. If possible, comment on prey availability and catchability effects. It is thought that if prey is scarce lobsters will be more likely to trap and this will be true at higher temperatures than lower. We did not examine the support for this hypothesis. It was pointed out that this would not affect the abundance index but would affect the spatial index.

2. Report or comment on results using just the spring fishery in LFA 33 and 34. Running the LFA 33 and 34 model for just the spring fishery should be done to determine if it insight into what to expect for LFA 27, which is a spring fishery, is provided.

Reasons for Lack of Fit in LFA 27:

1. LFA 27 is a spring fishery and hence molting may affect the assumption of a closed population.
2. If small lobsters 61-70 mm do not trap well the index for LFA 27 would be affected. However, there was no evidence that this was occurring.
3. Bait will be switched in warm and cold temperatures, this may have a greater affect in LFA 27 (bait is available in the data set)
4. In LFA 27, daily drops in temperature occur and there are some results that indicate lobsters react more to changes in temperature than absolute temperature in this LFA. These reductions in temperature are due to wind events. In LFA 27 depths are shallower, wind effects are important in LFAs 27-32.

It was **concluded** that:
1. Using the TCAI was appropriate for the LFA 33 assessment but not the LFA 27 assessment.
2. The TCAI would be included with a reiteration of the assumptions and indicate that it came from fixed stations and the area that it represents relative to the rest of the fishery.

Indicator of Abundance Pre-recruits and Legal Sizes CPUE in FSRS Traps in LFA 27:

The main conclusions with respect to deriving abundance indices (CPUE) for pre-recruits and legal size from the FSRS recruitment trap data were:
1. A model to standardize CPUE pre-recruits and legal sizes in LFA 27 was presented.
2. The most acceptable model supported by Akaike Information Criteria (AIC) and residual plots for pre-recruits was the full model without interaction terms for subarea byweek of season.
3. The most acceptable model for legals was the full model with all interaction effects.
4. As a result of the interaction terms, a model deriving annual abundance indices only for subareas in LFAS 27 was possible.
5. No agonistic behaviour effects on catchability were detected in the data. The relationship between the CPUE of legals and pre-recruits is slightly positive, indicating high numbers of one also produced high numbers of the other and it was concluded there was no detectable sign of interference between pre-recruits and legals in these traps.

It was **concluded** that the following concepts would be accounted for in providing advice in LFA 27 using this analysis.
1. Following the presentation there was considerable discussion on whether or not the results can be extrapolated to the entire population or commercial stock area. It was concluded that some commentary on this should be included when models using FSRS data are presented for the assessment
2. The FSRS recruitment trap data represents the best look at sub-legal population current status, however, the predictive ability of these data for future catches has been weak and no utility for prediction has yet been developed.
3. For the legal portion of the population, several steps are needed to evaluate how representative these analyses were for the entire population.
   a. For example the following comparisons would be helpful:
      i. size structure from port samples and at sea samples,
      ii. the geographic extent of commercial and FSRS traps,

iii. the depth distribution of at sea sample and FSRS samples, and
iv. voluntary log CPUE, FSRS trap CPUE, and Mandatory log CPUE.

b. Where these are similar, we would assume they were representing the same conclusions with respect to overall abundance.
c. If they differ, we would indicate which portion of the population was best represented by these data and determine the implications for impact on current stock status.

It was **concluded** that it would be important to include all data sources in the assessment of current stock status and that one set of data cannot **a priori** be replaced by another (see Appendix 5, for a summary of the final framework).

Research Recommendations:

1. A method to combine subarea indices into a single index for LFA 27 should be investigated (e.g. Weighting by sub area landings)
2. Currently the data are aggregated by week and using the raw daily data would allow temperature to be incorporated into the model and should be investigated.
3. A General Additive Model (GAM) could be used to describe non-linear effects.

Suggestions for Presentation:

1. Show confidence intervals on predictions from models.
2. Show the overall fit to the model where appropriate such as r-squared values.

Indicators of Abundance of Legal Sizes from Landings and Commercial Logs:

Examples of analyses that use CPUE and landings to draw conclusions on abundance trends were presented.

Criteria used to retain logbook data regardless of source were presented. These help to ensure consistency among data for annual comparisons.

It was **concluded** that long-term landings provide a good historical perspective. However, a final interpretation of these trends with respect to abundance over time could be presented that would take account of important social and economic changes. This issue would not have to be redone for each assessment.

Discussion focused on the varying quality among the data sets and the parts of the fishery that would be represented by the data sets (see Appendix 4 for result).

Research Recommendation:

A phone or interview project could be used to acquire historical anecdotal information that would help to standardize the method for taking social, economic, and effort changes into consideration.

Conclusions Objective #5: Select Indicators of Recruitment and Reproduction (Spawners)

Egg Production Index LFA 31A:

An egg production index based on sea sampling in LFA 31A was provided. The length-frequencies from the sea sampling are increased in proportion to the overall landings to create a length-frequency by number of berried females. Size-fecundity relationships are then used to provide an index of egg production based on this size distribution. The measure is considered an index because it does not take into account the possibility of multiple captures of berried females. In addition, the current indexes rely on landings as an indicator of abundance.

It was **concluded** to use this egg index as an indicator of changes in egg production for LFA 31A.

Research Recommendations:

1. Use tagging studies to investigate how often berried females are caught more than once in a season. This information could be used to adjust the egg index if annual variation is appreciable
2. Investigate whether the index would be better described using catch rate (mandatory logs) rather than landings.

Berried Female Index LFA 27:

Sea sampling in Little River a port of LFA 27 was used to develop an index (seasonal CPUE) of annual changes in numbers of berried females. The sampling occurs in May, June, and July.

It was **concluded** to use the changes in berried females from this sampling as an indicator of changes in berried females for LFA 27 and to list the assumptions identified below:

Assumptions:

1. Catchability assumed to be consistent over years and be equal for all sizes; trap design changes could be used to assess this assumption
2. Use catch rate as more standard method of calculating abundance of berried females.

Research Recommendation:

Determine the most consistent time of year to collect data for an egg production index, and optimize sampling design to take into account migration factors and possible changes in catchability and other factors. If the data collection occurs at only one time of year, a change in the size structure in the landings would affect the index. A range of time periods will be important to maintain to cover the entire migratory timing, changes in distribution and possible changes in catchability.

It was discussed generally the use of the FSRS recruitment traps to describe changes in berried female abundance. Concern was expressed about the utility of these traps because the selectivity (location) of the traps likely means that the potential numbers of berried females in these traps might be low. However, it was also thought that if the catchability remains the same each year that CPUE of berried females in these traps should be reported and used as the basis for an annual index. This index may be of more value in areas with a lower size at sexual

maturity since berried lobsters in these areas are smaller and more likely to be retained by the FSRS traps. There may be sufficient data from voluntary logbooks of fishermen with FSRS traps to compare berried female catch rate in commercial traps to the FSRS traps.

It was **concluded** to report on berried female CPUE in FSRS recruitment traps as a consistent source of data among LFAs but note the concern with catchability and representation of the total fishery. It was also **concluded** that individual research programs as described above for LFA 31A and LFA 27 would be important indicators of local changes in berried females and egg production.

Conclusions Objective #6: Select Indicators of Fishing Pressure

A method using the previously published continuous change-in-ratio (CCIR) technique was presented. This method provided statistically significant estimates of exploitation rate for all LFAs. The CCIR method can provide local, and length-specific estimates of exploitation rate as well as partial-season estimates. One of the advantages of the technique is that it can help assess the decline in exploitation rate that results from management measures such as increasing the Minimum Legal Size.

The published work can be found in:

Claytor, R.R., and J. Allard. 2003. Change-in-ratio estimates of lobster exploitation rate using sampling concurrent with fishing. Canadian Journal of Fisheries and Aquatic Sciences 60: 1190–1203.

It was **concluded** that the CCIR method would be the main method for estimating exploitation rate in LFAs 27-33 for the next assessment. It was also **concluded** that the exploitation values would be considered an index of exploitation rate in these fisheries for the following reasons:

1. The FSRS traps do not cover the entire fishing area.
2. The method has the advantage over some previous length-based methods of not being affected by recruitment fluctuations. It focuses on the harvestable population and the exploitation estimates do not account for protected portion of the population such as ovigerous females, window sized females (LFA 31a) or females above a maximum size (e.g. LFA 30)
3. Some estimates, while agreeing with other methods, seem unsustainably high (see research recommendation).

Research Recommendation:

The relationship between exploitation rate and spawning stock biomass should be investigated.

The following assumptions should be identified and commented on when using the CIR method.

1. Closed population assumption.
2. That the ratio of catchability between the classes is constant over the season
3. The ratio of catchability of the monitoring traps and of the commercial fishery traps is constant over the season for the exploited classes.
4. That the ratio of the commercial effort to the monitoring effort is either constant over the season or can be estimated up to a constant factor.
5. All of the assumptions will be better satisfied if the exploited and reference classes are biologically as similar as possible. In the case of lobster, two narrow, adjacent length classes will better satisfy the assumptions than either two wide classes or nonadjacent classes.

Other methods such as the Length Cohort Analysis (LCA) requires a strong assumption that recruitment is constant which is not being met in many of these LFAs.

It was suggested that the variation of size could be used as an indicator of population size structure. If the CV is large it indicates that it is coming from a population with a wide range in size. Suggestions on measures of this variation include coefficient of variation (CV), median absolute deviation (MAD)/Median would be a natural candidate (MAD = median absolute deviation), or semi-interquartile range/median or over mean.

Conclusions Objective #7: For the Selected Indicators Develop Candidate Reference Points that Would Form the Bases for Decisions by Fisheries Management

Reference points are being determined for all major Canadian fisheries. This initiative is occurring for several reasons:

1. Compliance with a Government of Canada Precautionary Approach (PA) policy
2. A requirement of eco-certification initiatives such as Marine Stewardship Certification (MSC)
3. A desire to take a more proactive rather than reactive approach to fisheries management.

Landings have been identified as an initial candidate for reference points in recent Integrated Fisheries Management Plans (IFMPs) in the Maritimes Region. Some alternatives were presented and a general discussion was held on the potential strengths and weaknesses of these candidates and the utility for reference points in the lobster fishery.

The outstanding points consisted of:

1. Landings have the advantage of a long time series but the best abundance indicators currently available appear to be those based on catch rates in FSRS traps.
2. It is important, where possible, to express the reference points as F or fishery removals on the y axis and biomass indicators on x axis over time how that has changed. This expression will be difficult to achieve with lobster and other methods will need to be explored.
3. Trend based – empirical approaches have the advantage of being based on historical data (the biological basis arises from experience rather than inherent biological properties) and the disadvantage that selection of a particular year in the series for an upper or lower reference point can be arbitrary.
4. In these cases, multiple indicators and a traffic light type approach would be beneficial.
5. Lobster assessment units under consideration appear to be well above upper stock reference points based on landings criteria used in other fisheries.
6. If indicators such as FSRS traps are used, there is concern because they represent only a portion of the fishery and lack of funding may terminate the availability of the data used to establish and test the reference point.
7. The biological bases for reference points in lobsters is not well established. The relationship between spawning stock size and subsequent recruitment is not well defined.
8. The lobster fishery is effort based and there are many safeguards that do not fit the classic reduction of TAC approach.
    a. These include a direct reduction in fishing effort in response to declining economics.
    b. Size limits to protect various reproductive components.
    c. Life-history safeguards: including discarding berried females for example
9. Whether or not fishing could clearly be identified as the reason for a decline. In other words, the population response to declines in effort are not well understood.

We made the distinction between the establishment of reference points and the harvest control rules that would arise if those points were reached. These would be established under different processes. It was also noted that Target Reference Points, while they would have a scientific element are primarily driven by social and economic considerations.

At the end of the discussion we were not able to strongly suggest a change from the landings based reference points developed in the IFMP and it is expected that the topic will continue to be explored in subsequent scientific and fishery advisory committees.

Conclusions Objective #8: Development of an Assessment Schedule, Including Guidelines for the Monitoring of the Indicators and Other Events that Would Trigger an Earlier than Scheduled Assessment

It was **concluded**:

1. That an assessment every 5 years was the most appropriate time interval between assessments.
2. The next assessment would be scheduled for sometime during the last ten days of July 2011.
3. The monitoring indicators that would be reported at advisory committees would be the FSRS CPUE of pre-recruits, landings from mandatory logs, and CPUE from mandatory logs.
4. We did not establish specific levels of these indicators that would trigger an earlier than scheduled assessment
5. The decision to call for an earlier than scheduled assessment would continue to rest with Fishery managers based on input received at the advisory committees.

Final Notes

Research Recommendations:

A workshop on influence of environmental variables on indicators that can be used to provide abundance was recommended. This was an issue associated with every indicator. We did not establish a mechanism or who should take the lead in developing this workshop. The RAP office has facilitated these types of workshops in the past and it could be developed with DFO Science taking the lead and working with the DFO RAP office. It is expected that input from various lobster advisory committees would be important in developing a terms of reference for such a workshop.

It was concluded that the following working papers would become Research Documents:

1. Framework for assessing Lobster off the coast of eastern Cape Breton and the eastern and south shores of Nova Scotia (LFAs 27-33) by J. Tremblay, D. Pezzack, C. Denton, A. Reeves, S. Smith, A. Silva and J. Allard
2. Lobster size at maturity estimates in Eastern Cape Breton, Nova Scotia by Alan Reeves, Jae Choi and John Tremblay
3. Recent studies of lobster size at maturity in Nova Scotia 2008-2010: Canso, Tangier, Port Mouton and Lobster Bay. By Angelica Silva, John Tremblay and Douglas Pezzack.
4. A primary paper lead by Jacques Allard is expected to provide the background for the temperature corrected abundance index (TCAI).

Appendix 5 provides a summary of the lobster framework, listing the indicators of stock status by category and data source by LFA. It was **concluded** that a table with this type of format provide a framework for summarizing the results and conclusions in the Science Advisory Report for the July 2011 assessment.

APPENDIX 1. Terms of Reference.

Maritimes Science Advisory Process to Review the Assessment Framework for LFA 27-33 Lobster

February 1-3, 2011

Chair: Ross Claytor

Northwest Atlantic Fisheries Organization (NAFO) Headquarters
2 Morris Drive, Suite 100
Burnside Industrial Park
Dartmouth, Nova Scotia

TERMS OF REFERENCE

Context

Lobsters (*Homarus americanus*) are found in coastal waters from southern Labrador to Maryland, with the major fisheries concentrated around the Gulf of St. Lawrence and the Gulf of Maine. Though lobster are most common in coastal waters, they are also found in deeper, warm water areas of the Gulf of Maine and along the outer edge of the continental shelf from Sable Island to off North Carolina.

The status of the lobster resources in Lobster Fishing Areas (LFAs) 27-33 was last assessed in 2004. Fisheries and Aquaculture management has requested updated information on the status of the LFA 27-33 lobster stocks, and a new assessment framework is required to establish the scientific basis for the provision of management advice in 2011.

Currently there are no direct indicators of abundance available for the lobster fishery and reference points in the draft IFMP have been tentatively framed in terms of landings. It is recognized that landings are not a very sensitive indicator of biomass given the influence of changes in effort, efficiency and catchability and there is a need to develop biologically-based reference points. The potential for alternate proxies for biomass will be evaluated.

Objectives

- Identify groups of LFAs for stock assessment
- Identify links between life-history (size-at-maturity, recruitment) and lobster management (update and reporting on information and assumptions used).
- Identify strengths and weaknesses of fishery data inputs for providing indicators of abundance, size structure, recruitment, effort, spatial distribution of catch.
    - Port and at sea sampling protocols
    - Observer sampling (including bycatch sampling associated with SARA)
    - Logbooks
    - Fishermen and Scientists Research Society (FSRS) information
- Select indicators of abundance, with a focus on a proposed catch rate model.
- Select indicators of recruitment and reproduction (spawners)

- Select indicators of fishing pressure.
- For the selected indicators develop candidate reference points that would form the bases for decisions by Fisheries Management.
- Development of an assessment schedule, including guidelines for the monitoring of the indicators and other events that would trigger an earlier than scheduled assessment.

Outputs

CSAS Research Document(s)
CSAS Proceedings

Participants

DFO Science
DFO FAM
Provincial representatives (NS)
Industry, including Lobster Advisory Committee members and FSRS members
External Reviewer(s)
NGOs
First Nations

APPENDIX 2. Agenda.

Maritimes Science Advisory Process to Review the Assessment Framework for LFA 27-33 Lobster

February 1-3, 2011

Chair: Ross Claytor

Northwest Atlantic Fisheries Organization (NAFO) Headquarters
2 Morris Drive, Suite 100
Burnside Industrial Park
Dartmouth, Nova Scotia

AGENDA

Tuesday, February 1st

10:30 Introduction and background

11:30 Identify groups of LFAs for stock assessment

12:30 Lunch (not provided)

13:30 Identify links between life-history (size-at-maturity, recruitment) and lobster management (update and reporting on information and assumptions used).

15:15 Break (coffee/tea provided)

15:30 Identify strengths and weaknesses of fishery data inputs for providing indicators of abundance, size structure, recruitment, effort, spatial distribution of catch and bycatch.

17:00 End

Wednesday, February 2nd

08:30 Identify strengths and weaknesses of fishery data inputs (cont'd)

09:30 Select indicators of abundance, with a focus on a proposed catch rate model

10:30 Break (coffee/tea provided)

10:45 Select indicators of abundance, with a focus on a proposed catch rate model.

12:30 Lunch (not provided)

13:30 Select indicators of recruitment and reproduction (spawners)

15:00 Break (coffee/tea provided)

15:15 Temperature-corrected abundance indicator – Jacques Allard

16:15 Select indicators of fishing pressure

Thursday, February 3rd

08:30 Select indicators of fishing pressure (cont'd)

10:15 Break (coffee/tea provided)

10:30 For the selected indicators develop candidate reference points that would form the bases for decisions by Fisheries Management.

12:00 Lunch (not provided)

13:00 For the selected indicators develop candidate reference points (cont'd)

15:00 Break (coffee/tea provided)

15:15 Development of an assessment schedule, including guidelines for the monitoring of the indicators and other events that would trigger an earlier than scheduled assessment.

16:00 Finalize Proceedings

17:00 End

APPENDIX 3. List of Participants.

Maritimes Science Advisory Process to Review the Assessment Framework for LFA 27-33 Lobster

February 1-3, 2011

Chair: Ross Claytor

Northwest Atlantic Fisheries Organization (NAFO) Headquarters
2 Morris Drive, Suite 100
Burnside Industrial Park
Dartmouth, Nova Scotia

LIST OF PARTICIPANTS

Name	Affiliation
Allard, Jacques	Universite De Moncton
Baker Stevens, Nellie	Eastern Shore Fisherman's Protectives Assn. (ESFPA)
Boudreau, Ginny	Guysborough Co. Inshore Fisherman's Assn. (GCIFA)
Boutilier, Randy	LFA 32
Brzeski, Veronika	Project Manager for the LFA 27 Management Board
Chen, Yong	University of Maine / Marine Sciences
Claytor, Ross	DFO Maritimes / PED
Den Heyer, Nell	DFO Maritimes / Dalhousie University (Reviewer)
Denny, Leon	Eskasoni Crane Cove Seafoods
Denton, Cheryl	DFO Maritimes / PED
Ferguson, David	President LFA 27 Management Board
Gaudette, Julien	PES, Science Branch, SABA
Greening, Linde	NS Fisheries and Aquaculture
Hubert, Nicholas	Unama'ki Institute of Natural Resources
Kehoe, Paul	CFA 24 (S-ENS), CORE AREA 29 REP
Lavallée, Jean	Atlantic Veterinary College
Leslie, Stefan	DFO Maritimes / FAM
MacDonald, Carl	DFO Maritimes / FAM
MacDonald, Gordon	CFA 23 (S-ENS), Traditional Fleet / LFA 30 FA
McIntyre, Tara	DFO Maritimes / CSA
O'Leary, Eugene	Guysborough Co. Inshore Fisherman's Assn. (GCIFA)
Pearo, Tricia	Fisherman & Scientists Research Society (FSRS)
Pezzack, Doug	DFO Maritimes / PED
Reeves, Alan	DFO Maritimes / PED
Richardson, Norma	Eastern Shore Fisherman's Protective Assn. (ESFPA)
Silva, Angelica	DFO Maritimes / PED
Smith, Stephen	DFO Maritimes / PED
Sweeney, Anne	DFO Maritimes / FAM (SWNS)
Tremblay, John	DFO Maritimes / PED

APPENDIX 4. Sources of catch and effort data.

	Strength	Weakness	Issues
Self Reporting Landings (1995-2004)	Daily catch for all fishermen.	No effort information. Limited location information (Port of sale). Variable trap design. No SOD recorded. Limited quality control. Short time series (1995-2004).	These were a transition from sales slips (landings only) to the full logs with effort and location. The completeness of the landings reported is unknown and may vary temporally and spatially.
Compulsory Logs (2005-present)	Daily catch and effort for all fishermen. Location information by grids fished. High compliance rate in recent years. Data entered by Dockside Monitoring companies and available within 1 month of logs submitted (logs submitted monthly). Digital entry of compulsory log makes reporting faster. In spite of some quality control issues 90% of data is useable.	Short time series (< 5 years). Variable trap design. No SOD recorded but can be calculated if all traps are hauled each data. Initial low compliance rate. Limited quality control. Reliability of data can be influenced by potential management implications . No place for berried lobsters (though when tried in earlier logs data was provided inconsistently and proved not useable).	While accuracy of some individual logs may be questioned, overall trends are believed reliable. Some problems exist with missing, incorrect or nonexistent grids, errors in port or Statistical area and unrealistic values for catch and effort. Improved quality control of the data provided by fishermen and in data entry could reduce these problems. Efforts have been made to do this with positive results but some problems still exist. Data can be edited to eliminate extreme values or a sub sample taken of fishermen with consistently reported complete information.

	Strength	Weakness	Issues
Voluntary Logs (1984-present)	Includes daily catch and effort of each participant. Additional information can be recorded (i.e. berried females). Long time series.	Voluntary with numbers low and declining over time. Depends on personal contact. Distribution based on location of volunteers so large areas not covered. Volunteers may not be representative. Variable trap design. Variable location information. No SOD recorded. Not a standardized data form so data recorded varies and data entry is more time consuming.	Provided valuable information on catch rates prior to the introduction of the compulsory logs and could be used along with the compulsory logs to extend the catch rate time series. A period of overlap would be needed to do the analysis needed. Following the introduction of compulsory logs the participation rate declined in most LFAs and the usefulness of continuing this program has been questioned.
FSRS Juvenile Traps	Catch and effort and size recorded for each fishing day. Distributed over much of the coast. Standardized traps. Theoretically fixed location. Temperature data available for each fisherman. Moderate time series in most areas (1999-present	Trap designed for small lobsters so may under represent larger sizes. Total trap numbers low with only two traps per fisherman so it does not represent entire catch. Voluntary and subject to changes in participants and participation rates. Deeper water areas further from coast under represented. Trap locations chosen by fisherman and theoretically not moved. Continued collection depends on governmental funding.	The traps provide a powerful tool providing data from a wide area over the entire season. As a voluntary system interest and dedication by the fishermen is key. Changes in participation rates would jeopardize the time series so depending solely on this data source may not be recommended.

	Strength	Weakness	Issues
FSRS Commercial Traps (data not used in this Framework assessment)	Catch and effort and size recorded for each fishing day. Temperature data available for many	Trap design variable. Small number of participants in LFA 33 only. Total trap numbers low so does not represent entire catch. Moderate time series. Voluntary and subject to changes in participants and participation rates. Locations chosen by fisherman. Continued collection depends on governmental funding.	As a voluntary system interest and dedication by the fishermen is key. Changes in participation rates would jeopardize the time series.

Sources of Size Data

	Strength	Weakness	Issues
Port Samples	Low cost per sample and logistically simple to undertake. Ability to sample several vessels catch in a day providing a potential for samples representing a wide area around the port. Provides sizes of landed catch.	Only the landed catch with no sublegal, window, oversize, berried females or v-notch lobsters. A subsample of the fisherman's catch and may not represent entire catch. No exact measure of effort, or location. No bycatch data.	The time series varies with LFA and with a few exceptions generally lack long term consistent sampling.
At Sea Samples	Entire catch available to sample including sublegal, berried, v-notched, window and oversize. By-catch data available. Exact location and depth. Trap by trap effort allows for calculation of CPUE. Shell condition data collected.	High sample cost. Limited to one vessels catch per day. In areas or time periods with low catch rates sample sizes are too small and additional samples required. Weather dependent. Additional training required for samplers and potential workplace health and safety issues.	The high unit cost has meant that the number of samples is low and in recent years has needed support from industry funding or special short term government funds. The time series varies with LFA and with a few exceptions, generally lack long term consistent sampling. Only sampling method that provides detailed information on non landed portion of the catch
FSRS Recruitment Traps	Sampled each fishing day over the entire season. Distributed over much of the coast. Known location and depth. Temperature data available for each fisherman.	Size groupings of 5 and 10mm. Traps designed for pre-recruits and may under sample larger sizes. Continued collection depends on governmental funding. Total trap numbers low with only two traps per fisherman so it does not represent entire catch.	The traps provide data from a wide area over the entire season. As a voluntary system interest and dedication by the fishermen is key. Changes in participation rates would jeopardize the time series. The large size groupings make it easy for fishermen to measure but they also reduce the ability to track smaller size changes and the sizes units do not always correspond with minimum, maximum or window sizes.

	Strength	Weakness	Issues
	Moderate time series in most areas (1999-present).	Voluntary and subject to changes in participants and participation rates. Deeper water areas further from coast under represented. Locations chosen by fisherman and may not represent the entire catch.	The traps were designed for smaller sizes and may reduce the catch of larger sizes. This becomes a concern in areas where larger sized lobsters are more abundant.

APPENDIX 5: Summary table of the lobster assessment framework developed during the meeting. In some cases the portion of the stock represented and the particular measurement to be presented during an assessment were not discussed. In these cases, a description of the portion of the stock represented by an indicator and the measurement would be presented during the assessment meeting. Conclusions from the assessment would be presented at the stock assessment meeting. Pre-recruits are defined as one molt away from the fishery.

Important Heading Definitions

Source of Indicator:
Reference, description in assessment, etc.

Portion of theStock Represented by Indicator (Geography, Time):
Geographic description of stock covered (percentage, depth range compared to total). Time covered annually and/or seasonally. Some indicators will use analyses that compare biological characteristics of the entire stock to a data set that is collected from a portion of the stock to determine the part of the stock a particular indicator represents. For example, length frequencies compared among data sets would be an indication of portion of the stock sampled by an indicator data set.

Indicator *LFA 27*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Ttime)	Measurement	Conclusion from Assessment
Fishery Performance				
Landings	LFA 27 Sales slips 47-1995	Whole, 47-95	Tonnes over time	
Landings	LFA 27Self reporting logs 1996-2006,	Whole, 1996-2006, based on port landed	Tonnes over time	
Landings	LFA 27 Mandatory logs	Whole fishery 2007 –present, north and south	tonnes over time	
Commercial CPUE unstandardized	LFA 27 Mandatory logs	Whole fishery 2007 –present, north and south (> 50%? of licenses/2007-2010)	CPUE (wt) over time	
Commercial CPUE unstandardized	LFA 27 Voluntary logs	84 –current, smaller portion of stock	CPUE (wt) over time	
Commercial CPUE unstandardized	FSRS voluntary logs 27	These could consist of FSRS recruitment trap logs 1999-present, or the FSRS voluntary logs beginning in 1994 depending on data recorded smaller portion of stock	Not available during the framework	

Indicator *LFA 27*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Ttime)	Measurement	Conclusion from Assessment
Median size in landed catch	LFA 27 – port sampling	Subsample (a few fishermen, a few ports and not all years); 1978 - 2010		
Percentage in first molt group landed catch	LFA 27 – port sampling	Subsample (a few fishermen, a few ports and not all years); 1978 - 2010		
Coefficient of variation (CV) around median length of port sample all LFAs	LFA 27 port sampling	Subsample (a few fishermen, a few ports and not all years); 1978 - 2010		
Effort	LFA 27 – mandatory logs	Whole fishery 2007 –present, north and south (> 50%? of licenses/2007-2010)	Trap hauls	
Effort	LFA 27 – mandatory logs	Whole fishery 2007 –present, north and south (> 50%? of licenses/2007-2010); 1996-2006 self reporting logs not presented at framework, will be examined	Days fished	
Size of Maturity –	LFA 27 pleopod cement gland staging (stage 2)	Xx% or range of xx% spawning before harvesting depending on time of year spawn before harvesting	Percentage of catch that is mature at a given size. Percent that mature before harvest based on ogive.	
Abundance				
Pre-recruits in 27	LFA 27 FSRS recruitment traps	Nearshore (to be examined for assessment) change in minimum legal size (MLS) standardized will be accounted for	CPUE index over time from GLM model (no./trap haul)	
Commercial sizes-	LFA 27 FSRS recruitment	Nearshore (to be examined for assessment)	CPUE index over time from GLM model (no./trap haul)	
Berried females	LFA 27 FSRS recruitment traps	Nearshore (to be examined for assessment)	CPUE over time (no./trap haul)	
Berried females	Little river sea samples LFA 27	Subsamples; 1993-2010	CPUE over time (no./trap haul)	
Berried females	Voluntary logs LFA 27	not presented at framework, will examine	CPUE over time (no./trap haul)	

Indicator *LFA 27*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
Egg Production Index	LFA 27 Little River sea samples	Subsamples; 1993-2010 + fecundity		
Fishing Pressure				
Exploitation rate CC/R	LFA 27 FSRS recruitment traps			

Indicator *LFA 28-32*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
Fishery Performance				
Landings	LFA 28-32 Sales slips 47-1995	Whole, 47-95	Tonnes over time	
Landings	IFA 28-32 Self reporting logs 1996-2006,	Whole, 1996-2006, based on port landed	Tonnes over time	
Landings	LFA 28-32 Mandatory logs	Whole fishery 2006 –present, (> 50%? of licenses/2007-2010) Separately by LFA and the sum	Tonnes over time	
Commercial CPUE unstandardized	LFA 28-32 Mandatory logs	Whole fishery 2006 –present, (> 50%? of licenses/2007-2010) Separately by LFA and the sum	CPUE over time	
Commercial CPUE unstandardized	LFA 28-32 Voluntary logs	1985 to 2003-2009 (depending upon LFA), small portion of stock. Not presented at framework, will examine data set	CPUE over time, kg/ th	
Commercial CPUE unstandardized	FSRS voluntary logs LFA 28-32	These could consist of FSRS recruitment trap logs 1999-present, or the FSRS voluntary logs beginning in 1994 depending on data recorded smaller portion of stock	CPUE kg/days fished	
Median size in landed catch	LFA 28-32 – port sampling	Subsample (a few fishermen, a few ports and not all years); 1980 - 2010		
% in first molt group landed catch	LFA 28-32 – port sampling	Sub sample (a few fishermen, a few ports and not all years); 1980 - 2010		

Indicator *LFA 28-32*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
CV around median of port sample all LFAs	LFA 28-32 – port sampling	Sub sample (a few fishermen, a few ports and not all years); 1980 - 2010		
Effort	LFA 28-32 – mandatory logs	Whole fishery 2006 –present, (> 50%? of licenses/2007-2010) Separately by LFA and the sum	Trap hauls	
Effort	LFA 28-32 – mandatory logs	Whole fishery 2006 –present, (> 50%? of licenses/2007-2010) Separately by LFA and the sum; 1996-2006 self reporting logs not presented at framework, will be examined	Days fished	
Size of Maturity – [SEE LFA 27]	LFA 29 mature cement glands (stage 2) size at 50% maturity	Xx% or range of xx% spawning before harvesting depending on time of year spawn before harvesting	Percentage of catch that is mature at a given size. Percent that mature before harvest based on ogive.	Has this increased over time or blocks of time, decreased.
	LFA 31A – mature cement glands (stage 2),	Xx% or range of xx% spawning before harvesting depending on time of year spawn before harvesting	Percentage of catch that is mature at a given size. Percent that mature before harvest based on ogive.	Has this increased over time or blocks of time, decreased.
Abundance				
Pre-recruits	LFA 28-32 FSRS recruitment traps	Near shore (to be examined for assessment) change in minimum legal size (MLS) standardized will be accounted for	CPUE index over time LFA 28 – 32 from GLM model (no./trap haul)	
Pre-recruits relative to change in MLS	LFA 31A sea samples	Near shore (to be examined for assessment)		
Commercial	LFA 28-32 FSRS recruitment traps	Near shore (to be examined for assessment)	CPUE index over time LFA 28 -32 from GLM model (no./trap haul)	

Indicator *LFA 28-32*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
Commercial	LFA 31A sea samples	4 years of sea sampling data,	2007 - present	
Berried females	LFA 29-32 FSRS recruitment traps	Near shore (to be examined for assessment)	CPUE over time (no./trap haul)	
Berried females	Voluntary logs LFA, 28-32	1985 to 2003-2009 (depending upon LFA), small portion of stock. Not presented at framework, will examine	no./trap haul	
Berried females	LFA 31A sea samples	2002-03, 2008-2010; LFA 27, 30 not presented at framework, will be examined	no./trap haul	
Egg Production Index	LFA 31A	2002-03, 2008-2010; based on Sea sampling and landings LFA 27, 30 not presented at framework, will be examined		
Fishing Pressure				
Exploitation rate CCIR	LFA 28-32 FSRS recruitment traps	Near shore (to be examined for assessment)		

Indicator *LFA 33*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
Fishery Performance				
Landings	LFA 33 Sales slips 47-1995	Whole, 47-95, based on port landed	Tonnes over time	
Landings	IFA 33Self reporting logs 1996-2006,	Whole, 1996-2006, based on port landed	Tonnes over time	
Landings	LFA 33 catch Mandatory logs	Whole fishery, 2006-present	Tonnes over time	
Commercial CPUE unstandardized	LFA 33 Mandatory logs	Whole fishery 2007 –present, east and west (> 50%? of licenses/2007-2010)	CPUE over time, kg/trap haul	
Commercial CPUE unstandardized	LFA 33 Voluntary logs	Sub sample (a few fishermen, a few ports and not all years); 1978 - 2010	CPUE over time kg/trap haul	

Indicator *LFA 33*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
Commercial CPUE unstandardized	LFA 33 FSRS commercial traps	Sub sample (a few fishermen, a few ports and not all years); these began after 2000.	Not available yet no./th	
Commercial CPUE unstandardized	FSRS voluntary logs LFA 33	These could consist of FSRS recruitment trap logs 1999-present, or the FSRS voluntary logs beginning in 1994 depending on data recorded smaller portion of stock	CPUE kg/days fished	
Median size in landed catch	LFA 33 – port sampling or sea sampling data	Sub sample (a few fishermen, a few ports and not all years); 1978 - 2010		
% in first molt group landed catch	LFA 33 – port sampling	Whole fishery 2007 –present, east and west (> 50%? of licenses/2007-2010)		
CV around median of port sample all LFAs	LFA 33 – port sampling	Subsample (a few fishermen, a few ports and not all years); 1978 - 2010		
Effort	LFA 33 – mandatory logs	Subsample (a few fishermen, a few ports and not all years); 1978 - 2010	Trap hauls	
Effort	Self reporting dataLFA 33 – mandatory logs	Whole fishery 2007 –present, east and west (> 50%? of licenses/2007-2010) 1996-2006 self reporting logs not presented at framework, will be examined	Days fished	
Size of Maturity – [SEE LFA 27]	LFA 33 mature cement glands (stage 2) size at 50% maturity	Xx% or range of xx% spawning before harvesting depending on time of year spawn before harvesting	Percentage of catch that is mature at a given size. Percent that mature before harvest based on ogive.	Has this increased over time or blocks of time, decreased.
Abundance				
Pre-recruits	LFA 33 FSRS recruitment traps	Near shore (to be examined for assessment) change in minimum legal size (MLS) standardized will be accounted for	CPUE index over time LFA 33 temperature corrected CPUE (no./trap haul)	
Pre-recruits	LFA 33 FSRS recruitment traps	Near shore (to be examined for assessment)	CPUE index over time from GLM model (not	

Indicator *LFA 33*	Source of Indicator	Portion of the Stock Represented by Indicator (Geography, Time)	Measurement	Conclusion from Assessment
			corrected for temperature) (no./trap haul)	
Legal	LFA 33 FSRS commercial traps	to be examined for assessment)	Not looked at in framework	
Legal -	LFA 33 FSRS recruitment traps	Near shore (to be examined for assessment) Limited geographic	CPUE index over time from GLM model (not corrected for temperature) (no./trap haul)	
Berried females	LFA 33 FSRS commercial traps	Near shore (to be examined for assessment)	Not available yet (no./trap haul)	
Berried females	LFA 33 FSRS recruitment traps	Near shore (to be examined for assessment)	CPUE over time (no./trap haul)	
Berried females	Voluntary logs LFA 33	1985 to 2003-2009 (depending upon LFA), small portion of stock. Not presented at framework, will examine data set	(no./trap haul)	
Egg Production Index	Not available for LFA 33			
Fishing Pressure				
Exploitation rate CCIR	LFA 33 FSRS recruitment traps	Near shore (to be examined for assessment)		